FULL CONTENTS

[Claim(s)]

[Claim 1] The 1st measurement means which measures the phase of the current supplied from the 1st and 2nd high frequency power supply which supplies electric power to an electric supply line, and said 1st high frequency power supply, The 2nd measurement means which measures the phase of the current supplied from said 2nd high frequency power supply, The phase of the current measured with said 1st measurement means is compared with the phase of the current measured with said 2nd measurement means. Have a phase contrast detection means to detect the phase contrast of both current, and the drive pulse supplied to said 2nd high frequency power supply according to the phase contrast detected with this phase contrast detection means is controlled. Non-contact electric supply equipment characterized by coinciding the phase of the current outputted from said 2nd high frequency power supply with the phase of the current outputted from said 1st high frequency power supply.

[Claim 2] A standard signal output means to output the current phase standard signal which has two or more high frequency power supplies which supply electric power to an electric supply line, and serves as a standard of the current phase of this high frequency power supply, A measurement means to measure the phase of the current outputted from said high frequency power supply, and the phase of the current measured with this measurement means, Non-contact electric supply equipment characterized by having a phase comparison means to compare the phase of the standard signal outputted from said standard signal output means, and a current supply means to create the current of predetermined frequency from the phase contrast detected with this phase comparison means, and to supply said electric supply line.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the non-contact electric supply equipment which supplies electric power to an electromotive mobile by non-contact.

[0002]

[Description of the Prior Art] Mobiles, such as the self-propelled vehicles which carry parts, a product, etc. in a factory, for example, the vehicles for a ceiling run, and vehicles for automatic warehouse systems, are known as an electromotive mobile today. As one of the means to supply electric power to such an electromotive mobile, the non-contact electric supply equipment for supplying electric power to a mobile by non-contact is proposed.

[0003] Drawing 6 is a figure explaining conventional non-contact electric supply equipment. In this figure, the base material 3 which supports an electric supply line 2 is attached to the side of the rail 1 instituted by a ceiling or a floor of the factory etc. The E form core 4 attached to the vehicles side which are not illustrated [which is a mobile] is arranged so that an electric supply line 2 may be located in the crevice, and it drives vehicles by sending high frequency current through an electric supply line 2 using the electric power induced by the E form core 4.

[0004] Moreover, supply of the electric power to an electric supply line 2 is performed by the high frequency power supplies 5 and 6 prepared, for example in the both ends of the electric supply line 2. In addition, the high frequency power supply 5 supplies electric power to the electric supply line 2a on the left of the dashed line shown in this figure, and the high frequency power supply 6 supplies electric power to the electric supply line 2b on the right of the dashed line shown in this figure. Therefore, the termination of each electric supply line 2a and 2b is located in the portion omitted with the dashed line.

[0005] Drawing 7 is the circuit block diagram of the conventional high frequency power supply 5 (or 6). The exchange current supplied from an exchange power supply (commercial power) is transformed into direct-current current by the rectification circuit 7, and is supplied to the chopper circuit 8. The drive pulse of the predetermined cycle (for example, frequency of 10kHz) outputted from the drive pulse generating circuit 10 is supplied to the chopper circuit 8, and the chopper circuit 8 transforms direct-current current into exchange current according to the output frequency of this drive pulse, and supplies it to the above-mentioned electric supply line 2a (or 2b). In addition, the drive pulse to output **** and creates the reference pulse of the reference pulse generating circuit 9 arranged by the preceding paragraph from the drive pulse generating circuit 10.

[0006] Above-mentioned circuit composition is the same in the high frequency power supplies 5 and 6, and outputs above-mentioned exchange current based on the reference pulse outputted from the reference pulse generating circuit 9 built in separately, respectively.

[0007]

[Problem to be solved by the invention] The following problems occur in the above-mentioned

conventional non-contact electric supply equipment. That is, since the above-mentioned reference pulse generating circuit 9 is established independently in both circuits, respectively, though the metaphor output frequency is in agreement, phase contrast may exist among both pulses.

[0008] While phase contrast arises between the current outputted from both the high frequency power supplies 5 and 6 in this case and the E form core 4 is straddling both the electric supply lines 2a and 2b, electric power is consumed vainly. For example, if the phase contrast of 180 degrees is between both the high frequency power supplies 5 and 6 as shown in drawing 8 , it generates in the opposite direction, and it will mean that the output of two power supplies had short-circuited through the E form core 4, and problems, such as abnormalities in an over-current, will generate the electromotive force induced by the above-mentioned E form core 4 in the high frequency power supplies 5 and 6.

[0009] Then, in order to lose the phase contrast generated between both the high frequency power supplies 5 and 6, the high frequency power supply shown in drawing 9 is also proposed. That is, the reference pulse generating circuit 9 is carried out in common, a reference pulse is supplied to the high frequency power supplies 5 and 6 (drive pulse generating circuits 10a and 10b) from the same reference pulse generating circuit 9, and the electric power supply which does not have phase contrast in electric supply lines 2a and 2b through the chopper circuits 8a and 8b is performed.

[0010] However, though a metaphor reference pulse is coincided, phase contrast arises on the current outputted by an electric supply line 2a, the capacity between lines between 2b, the difference of an inductance, etc. from the high frequency power supplies 5 and 6.

[0011] This invention offers the non-contact electric supply equipment which loses more certainly the phase contrast of the current supplied to an electric supply line in view of the above-mentioned technical problem.

[0012]

[Means for solving problem] The 1st and the 2nd high frequency power supply which supply electric power to an electric supply line in order that invention according to claim 1 may solve the above-mentioned technical problem, The 1st measurement means which measures the phase of the current supplied from said 1st high frequency power supply, The 2nd measurement means which measures the phase of the current supplied from said 2nd high frequency power supply, The phase of the current measured with said 1st measurement means is compared with the phase of the current measured with said 2nd measurement means. Have a phase contrast detection means to detect the phase contrast of both current, and the drive pulse supplied to said 2nd high frequency power supply according to the phase contrast detected with this phase contrast detection means is controlled. It can attain by offering the non-contact electric supply equipment which coincides the phase of the current

outputted from said 2nd high frequency power supply with the phase of the current outputted from said 1st high frequency power supply.

[0013] Here, an electric supply line is an electric supply line arranged along with the rail for automatic warehouse systems, the rail for ceiling run vehicles, etc., for example, a litz wire etc. is used. Moreover, the 1st and 2nd high frequency power supply is prepared in the run course for which the both ends of an electric supply line and a run course branch in the middle of them, and supplies the electric power of a predetermined cycle to an electric supply line. Moreover, the 1st and 2nd measurement means measures the phase of the current supplied to an electric supply line, for example, consists of CT(s) (current transmission) etc. Furthermore, a phase contrast detection means detects the phase contrast of the current measured with the 1st and 2nd measurement means.

[0014] Thus, by constituting, the high frequency current which amended phase contrast from the 2nd high frequency power supply according to the phase contrast of both the current detected with the phase contrast detection means is supplied, and high frequency current without phase contrast is supplied from the 1st and 2nd high frequency power supply.

[0015] For example, if the output timing of a drive pulse is shifted greatly and phase contrast becomes small when the phase contrast of both current is large, the output timing of a drive pulse will shift and quantity will be made small, and it controls so that the phase of both current is in agreement. Therefore, the phase of the current outputted from the 1st and 2nd high frequency power supply is controlled in the direction which is automatically in agreement, and it can perform phase control of supply current, without performing adjustment of a reference pulse etc.

[0016] A standard signal output means to output the current phase standard signal which has two or more high frequency power supplies which supply electric power to an electric supply line, and serves as a standard of the current phase of this high frequency power supply in order that invention according to claim 2 may solve the above-mentioned technical problem, A phase comparison means to compare a measurement means to measure the phase of the current outputted from said high frequency power supply with the phase of the current measured with this measurement means and the phase of the standard signal outputted from said standard signal output means, The current of predetermined frequency is created from the phase contrast detected with this phase comparison means, and it can attain by offering the non-contact electric supply equipment which has a current supply means to supply said electric supply line.

[0017] This example is non-contact electric supply equipment by which two or more high frequency power supplies are connected to an electric supply line. An electric supply line is an electric supply line arranged as well as the above-mentioned case along with the rail for automatic warehouse systems, the rail for ceiling run vehicles, etc., and the 1st and 2nd high

frequency power supply is arranged at the run course for which the both ends of an electric supply line and a run course branch in the middle of them, and supplies the electric power of a predetermined cycle to an electric supply line. Moreover, the measurement means also consists of CT(s) etc., for example. On the other hand, a standard signal generation means is a signal generation means used as the standard at the time of comparing a current phase, for example, sets up the signal which includes current topology suitable as a standard signal beforehand.

[0018] Thus, by constituting, the phase of the current outputted from two or more high frequency power supplies is controlled in the direction which is automatically in agreement, and it can perform phase control of supply current, without performing adjustment of a reference pulse etc.

[0019]

[Mode for carrying out the invention] The example of an embodiment of this invention is hereafter explained in detail with reference to Drawings. Drawing 2 is the system composition figure of the non-contact electric supply equipment of this example of an embodiment. Also in this example, the high frequency power supplies 15 and 16 are formed in the both sides of the electric supply line 12, respectively. Here, the electric supply line 12 (12a, 12b) is attached to the base material 13 formed in the side of the rail 11 at intervals of predetermined. Moreover, a mobile 14 runs along with the above-mentioned rail 11, and the driving force of a mobile 14 receives transmitted electricity with Core (E form core) 14a. Here, the current supplied from the high frequency power supply 15 flows into an electric supply line 12a, and the current supplied from the high frequency power supply 16 flows into an electric supply line 12b. Moreover, each electric supply lines 12a and 12b have the end of the form of 12a and 12b shown in drawing 2 , respectively.

[0020] Drawing 3 shows the physical relationship of the E form core 14 to the above-mentioned electric supply line 12a (or 12b) with a sectional view. As shown in this figure, two electric supply lines 12a (12b) are located in two crevices of the E form core 14a, and form in the E form core 14a the magnetic flux created by the current which flows through an electric supply line 12a (12b). The current created by this magnetic flux flows into Coil 14b, and this current is supplied to the drive motor in a mobile 14 etc.

[0021] On the other hand, supply of electric power is performed from the electric supply line 12a which constitutes non-contact electric supply equipment, the high frequency power supply 15 which corresponds to 12b as mentioned above, or 16, and this composition is shown in drawing 1 . In addition, although the high frequency power supplies 15 and 16 shown in drawing 1 approach and are shown, it is in the position which hundreds of m distance left in fact.

[0022] The high frequency power supply 15 supplies electric power to an electric supply line

12a, and the high frequency power supply 16 supplies electric power to an electric supply line 12b. Moreover, CT1 is prepared in the position of the electric supply line 12a near the high frequency power supply 15, and the current which flows through an electric supply line 12a by this CT1 is detected. This current is supplied to the PLL circuit / VCO circuit 17 of the high frequency power supply 16. Moreover, CT2 are prepared in the position of the about 16 high frequency power supply electric supply line 12b, the current which flows into an electric supply line 12b is detected, and above-mentioned PLL circuit / VCO circuit 17 are supplied. The circuit of drawing 1 is explained concretely hereafter.

[0023] Drawing 4 is a circuit in the above-mentioned high frequency power supply 15, and consists of the reference pulse generating circuit 20, a drive pulse generating circuit 21, a rectification circuit 22, and a chopper circuit 23. The reference pulse generating circuit 20 consists of oscillating circuits, such as a crystal oscillator, for example, and supplies an oscillation pulse to the drive pulse generating circuit 21. The drive pulse generating circuit 21 **** the oscillation pulse to input, for example, creates a 10kHz drive pulse, and outputs it to the chopper circuit 23. On the other hand, after exchange current is supplied to the rectification circuit 22 and changed into direct-current current by the rectification circuit 22, the chopper circuit 23 is supplied.

[0024] The drive pulse which direct-current current is supplied to the chopper circuit 23 from the above-mentioned rectification circuit 22, and a drive pulse is supplied from the drive pulse generating circuit 21, and is supplied in the chopper circuit 23 is followed, and direct-current current is turned on and turned off, for example, 10kHz high frequency current is supplied to an electric supply line 12a.

[0025] On the other hand, the high frequency power supply 16 consists of the PLL/VCO circuit (a PLL circuit only shows hereafter) 17, a drive pulse generating circuit 24, a rectification circuit 25, and a chopper circuit 26, as shown in above-mentioned drawing 1 . Detection current is supplied to the PLL circuit 17 from CT1, detection current is further supplied also from CT2, and it becomes the comparison value of the PLL circuit 17. In addition, both above-mentioned detection current is supplied to the phase comparison machine which is not illustrated in the PLL circuit 17, and the phase of both current is compared by this phase comparison machine.

[0026] The comparison result with a comparison machine is outputted to VCO (voltage control oscillator), the reference pulse based on a comparison result is created, and this data is supplied to the drive pulse generating circuit 24. In the drive pulse generating circuit 24, the drive pulse according to a reference pulse is outputted to the chopper circuit 26. Moreover, like the above-mentioned rectification circuit 22, the rectification circuit 25 rectifies exchange current and supplies it to the chopper circuit 26.

[0027] The chopper circuit 26 is the drive pulse outputted from the drive pulse generating circuit 24, and outputs the rectification current supplied from the rectification circuit 25 to an

electric supply line 12b, for example as 10kHz high frequency current.

[0028] In the non-contact electric supply equipment of the above composition, the processing operation is explained below. First, the reference pulse generating circuit 20 is driven, an oscillation pulse is supplied to the drive pulse generating circuit 21, a drive pulse is outputted to the chopper circuit 23 from the drive pulse generating circuit 21, and high frequency current is supplied to an electric supply line 12a from the chopper circuit 23.

[0029] High frequency current flows into an electric supply line 12a, and an electric power supply is performed to an electric supply line 12a by the current supplied from the above-mentioned high frequency power supply 15. This current is current of the phase which has the frequency of 10kHz and balanced the arrangement conditions of the electric supply line 12a etc. CT1 detects the current which flows through a power line 12a, and it supplies it to the PLL circuit 17.

[0030] On the other hand, the high frequency power supply 16 also starts a drive, and current is supplied to an electric supply line 12b from the high frequency power supply 16. And the detection current from CT2 prepared in the electric supply line 12b is also supplied to the PLL circuit 17, the phase of both current is compared by the phase comparison machine in the PLL circuit 17, and it is outputted to the drive pulse generating circuit 24 through VCO.

[0031] As opposed to the current into which the drive pulse supplied to this drive pulse generating circuit 24 actually flows through electric supply lines 12a and 12b. Therefore, the frequency of the current which actually flows through electric supply lines 12a and 12b, and the information on a phase are included, and the pulse signal including such information is supplied to the drive pulse generating circuit 24. That is, the current supplied to electric supply lines 12a and 12b is current which amended the phase of the current measured by CT2 by making into a standard the current detected by the above-mentioned CT1.

[0032] Therefore, it is current by which the capacity between lines of electric supply lines 12a and 12b, the difference of the inductance corresponding to the arrangement length of electric supply lines 12a and 12b, etc. were amended, and is current frequency and whose phase corresponded to the current supplied from the high frequency power supply 15. By supplying such current, even if it supplies high frequency current from two high frequency power supplies 15 and 16, the current which does not have phase contrast mutually can be supplied to electric supply lines 12a and 12b.

[0033] In addition, although direct current was measured from electric supply lines 12a and 12b by CT1 and 2 in the above-mentioned example of an embodiment, as shown in drawing 5 , it is good also as composition which supplies a reference pulse to each high frequency power supplies 15 and 16 etc. from the current phase reference pulse generating circuit 28.

[0034] namely, -- outputting a current phase reference pulse to each high frequency power supplies 15 and 16 and ... from the current phase reference pulse generating circuit 28, as

shown in this figure -- each high frequency power supplies 15 and 16 and ... the inner PLL circuit 29 is supplied. Current data has inputted from CT prepared in the PLL circuit 29 at the electric supply line 12a, and the PLL circuit 29 compares both current and outputs a comparison result to the drive pulse generating circuit 30. [also in this case, the pulse signal supplied to the drive pulse generating circuit 30] The 10kHz drive pulse outputted from the reference pulse generating circuit 30 [a reference pulse] therefore in the measured value of the current which flows into an electric supply line 12a is a pulse by which the phase was amended by the PLL circuit 29, and the current where no phase contrast is in each electric supply lines 12a and 12b is supplied.

[0035]

[Effect of the Invention] Since phase contrast does not arise to the electric power supplied even when supplying electric power from two or more high frequency power supplies according to this invention as explained above, power loss appearance can be prevented.

[0036] Moreover, the magnetic field which disagrees with a core does not occur and the abnormalities in an over-current etc. do not occur to a high frequency power supply.

[Brief Description of the Drawings]

[Drawing 1] It is the circuit block diagram of a high frequency power supply.

[Drawing 2] It is the system composition figure of the non-contact electric supply equipment of this example of an embodiment.

[Drawing 3] A sectional view shows the physical relationship of E form core to an electric supply line.

[Drawing 4] It is the figure which explains a part to the concrete circuit in a high frequency power supply.

[Drawing 5] It is the modification of a high frequency power supply circuit.

[Drawing 6] It is a figure explaining conventional non-contact electric supply equipment.

[Drawing 7] It is the circuit block diagram of the conventional high frequency power supply.

[Drawing 8] It is a figure explaining the example which becomes the phase contrast of 180 degrees is between both high frequency power supplies, and the current outputted from both the high frequency power supply is offset, and useless [big electric power].

[Drawing 9] It is the circuit block diagram showing example of another of the conventional high frequency power supply.

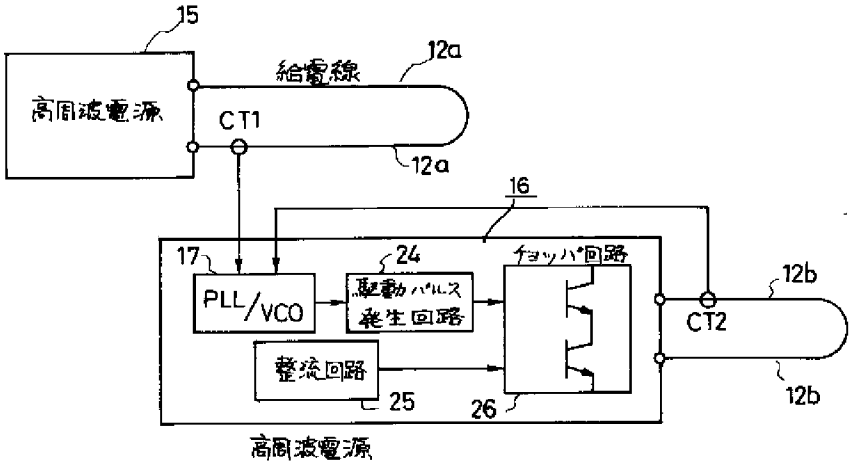
[Explanations of letters or numerals]

11 Rail

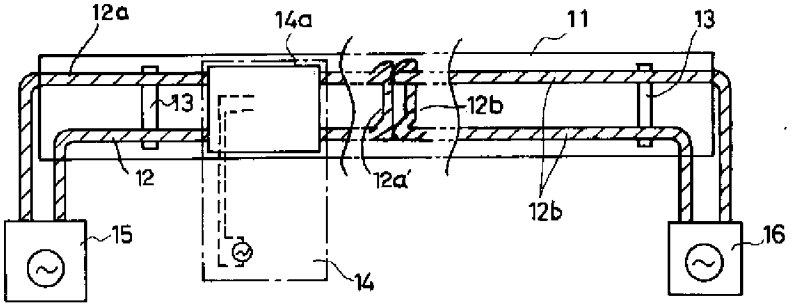
12a, 12b Electric supply line

13 Base Material
14 Mobile
14a E form core
14b Coil
15, 16 High frequency power supply
17, 29 PLL circuit
20 Reference Pulse Generating Circuit
21, 30 Drive pulse generating circuit
22 Rectification Circuit
23 Chopper Circuit
24 Drive Pulse Generating Circuit
25 Rectification Circuit
26 Chopper Circuit

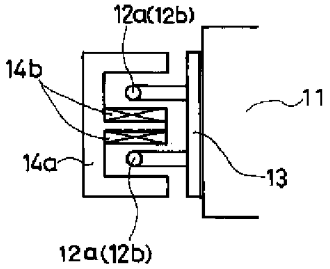
[Drawing 1]



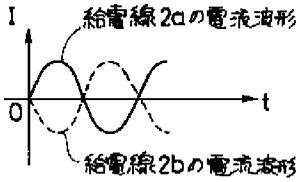
[Drawing 2]



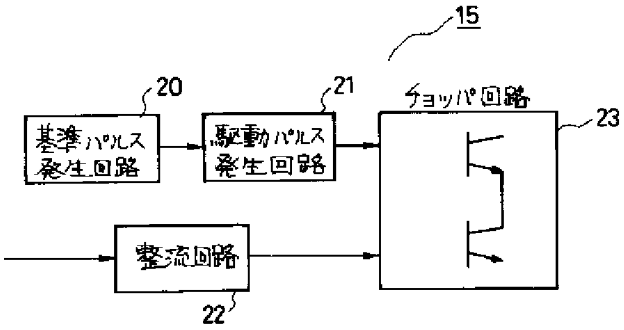
[Drawing 3]



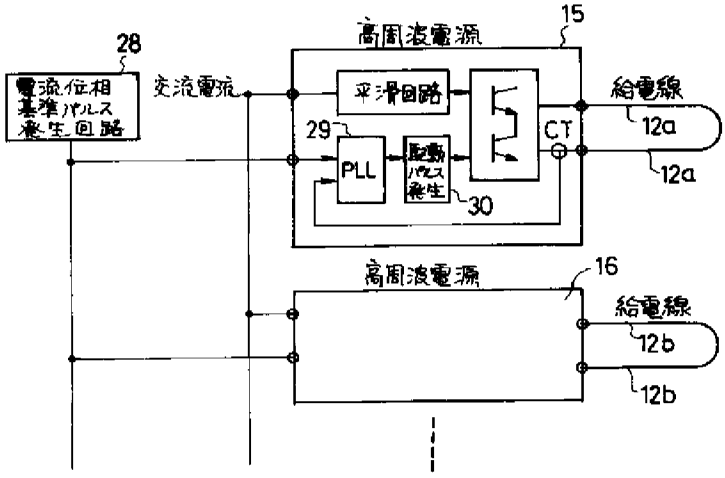
[Drawing 8]



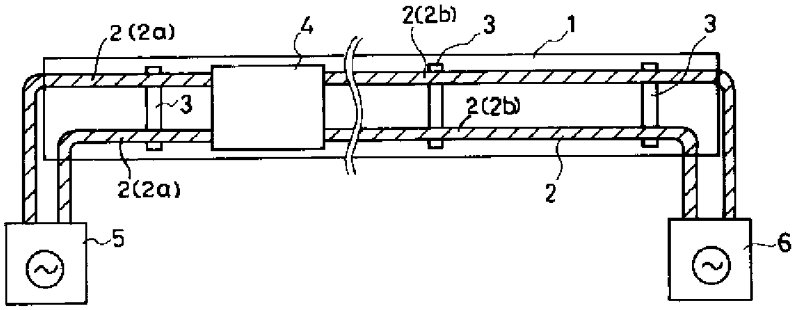
[Drawing 4]



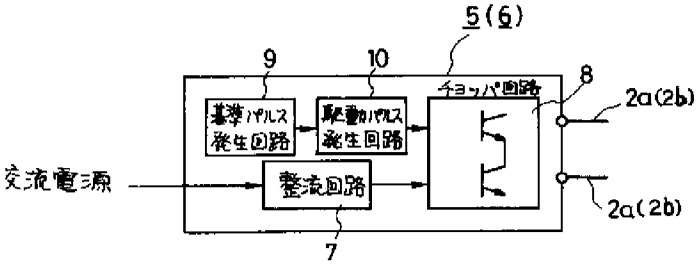
[Drawing 5]



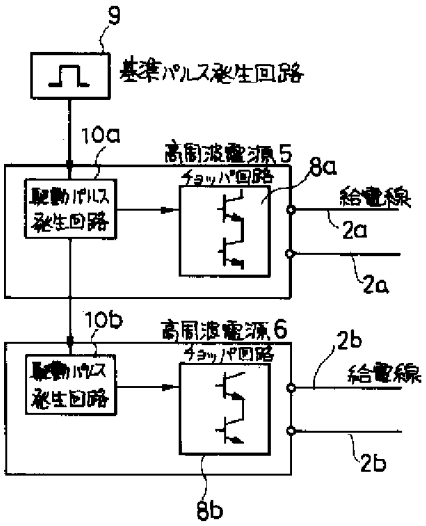
[Drawing 6]



[Drawing 7]



[Drawing 9]



[Translation done.]